AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 98

THE BERNARD 20 C.1 (FRENCH)

A Single-Seat Pursuit Monoplane

Washington
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THE BERNARD 20 C.1 (French)*

A Single-Seat Pursuit Monoplane

The Bernard 20 C.1, which has made its first trial flights is constructed entirely of wood, with the exception of a few fittings, and consists of four main parts: a one-piece wing whose raised middle section forms the middle section of the fuselage, a rear section carrying the tail surfaces, an engine mount, and a landing gear - these four parts being assembled by quickly detachable joints.

The wing consists of narrow juxtaposed box girders with spruce flanges, forming the surface of the wing, and plywood webs, the framework being completed by a series of leading-edge and trailing-edge sections, box ribs and strips of wood. In the center these members cross at a height to form the middle portion of the fuselage. It was thus possible to form a continuous girder of great strength, while reserving a central space of sufficient dimensions for the front part of the cockpit. A steel tube traverses this block at each corner with attachments for the engine mount in front and the fuselage in the rear. The following static tests were all successfully withstood by the same wing: a partial bending test with a load

*From L'Aéronautique, May, 1929, p.145-149.

factor of 8; a torsional test with a load factor of 2.5, by means of frames surrounding the profile and carrying a planking on which were placed sand bags to a total of 3000 kg (6614 lb.), which thus acted on a lever arm of 2 m (6.56 ft.); lastly, a bending test to the point of rupture, which gave a safety factor of 13.2, the required factor being 13. The very slender ailerons are actuated by rigid controls.

The framework of the rear part of the fuselage comprises two vertical box girders constituted by two longerons with uprights, cross pieces and transverse formers. It has a double covering, the inside one being reinforced by narrow longitudinal strips. The front part of the fuselage carries four fittings for attaching it to the wing. The rear part is perforated for the passage of the stabilizer, which is in one piece and has four points of fixation. The elevator is in two parts. The tail surfaces have a structure similar to that of the wing.

The engine-propeller block is a duralumim shell which forms the nose and is attached by four bolts to tubes traversing the central part of the wing. It is equipped with a direct-drive Hispano-Suiza engine of 400 hp. Accessibility is assured by large panels on longitudinal hinges like the hood of an automobile. There are dumpable fuel tanks in the wing on both sides of the fuselage. The oil tank is in the engine sectiom with the oil radiator, which is flush with the outside of the fuselage. The water radiator is under the wing.

The landing gear is formed by two panels of laminated wood, one attached to each side of the enlarged central section of the wing. The lower ends are connected by two tubes, between which are the two half-axles. Bechereau shock absorbers are used in combination with elastic cords, the whole being enclosed in the panels.

The cockpit has a seat which is adjustable during flight at the will of the pilot. This device should be generally adopted. Protection is provided, in case of capsizing, by a very high windshield of steel tubes capable of withstanding stresses of 4000 to 5000 kg (9000 to 11000 lb.), and a large head rest similarly reinforced. There is an opening 50 cm (20 in.) high, through which the pilot can escape when the airplane is completely overturned on the ground.

The Bernard Company has solved the problem of transporting the airplane along the highways by a special steel-tubing support which enables the easy disassembling of the fuselage and wing. A false central part is then substituted, likewise made of steel tubing, and the assembly of the engine block, fuselage, tail surfaces and landing gear is ready to take the road on its wheels, the wing being transported on a trailer.

The L/D ratio of 13.5, the greatest value thus far attained with a single-seater, gives reason to expect performances superior to those of other airplanes of the same class.

General Characteristics

Span	10.80 m.	35.43 ft.
Length	7.45 "	24.44 "
Height	2.50 "	8.20 "
Wing area	16.70 m^2	179.76 sq.ft.
Weight empty	1023 kg	2255.3 lb.
Useful load	347 "	765.0 "
Full load	1370 "	3020.3 "
Wing loading	82 kg/m^2	16.80 lb./sq.ft.
Power "	3.42 kg/hp	7.44 lb./hp
Power per unit area	24 hp/m^2	2.23 hp/sq.ft.

Performances*

Speed at ground level	330 km/h	205 mi./hr.
Speed at 4000 m (13123 ft.)	320 km/h	199 mi./hr.
Ceiling	9250 m	30348 ft.

*From L'Aéronautique, June and July, 1928, p.5 of "Répertoire Commercial."

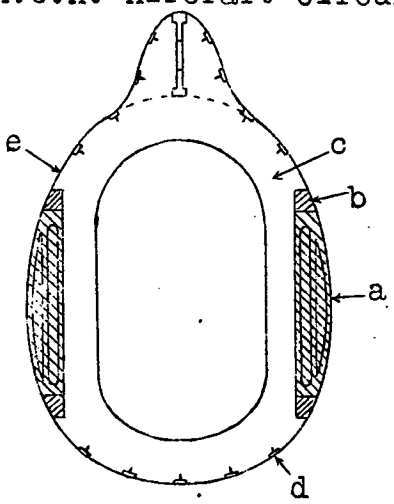
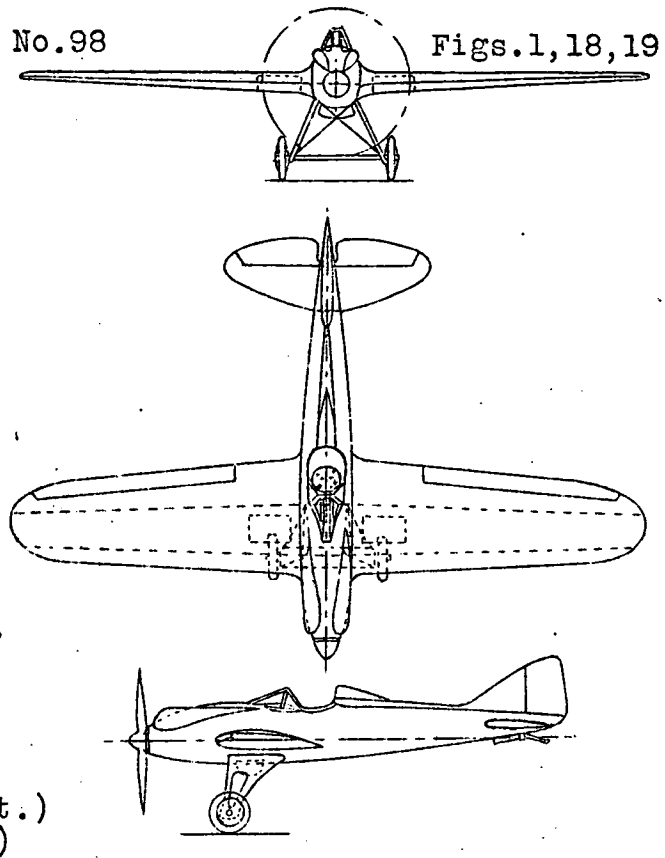


Fig.18 Cut through rear section of fuselage. a, side girder; b, longeron; c, frame; d, longitudinal strip; e, plywood covering.



Span	10.80 m	(35.43 ft.)
Length	7.45 m	(24.44 ")
Height	2.50 m	(8.20 ")
Wing area	16.70 m^2	(179.76 sq.ft.)

Fig.1 General arrangement drawing of the Bernard 20 C-1 pursuit airplane.

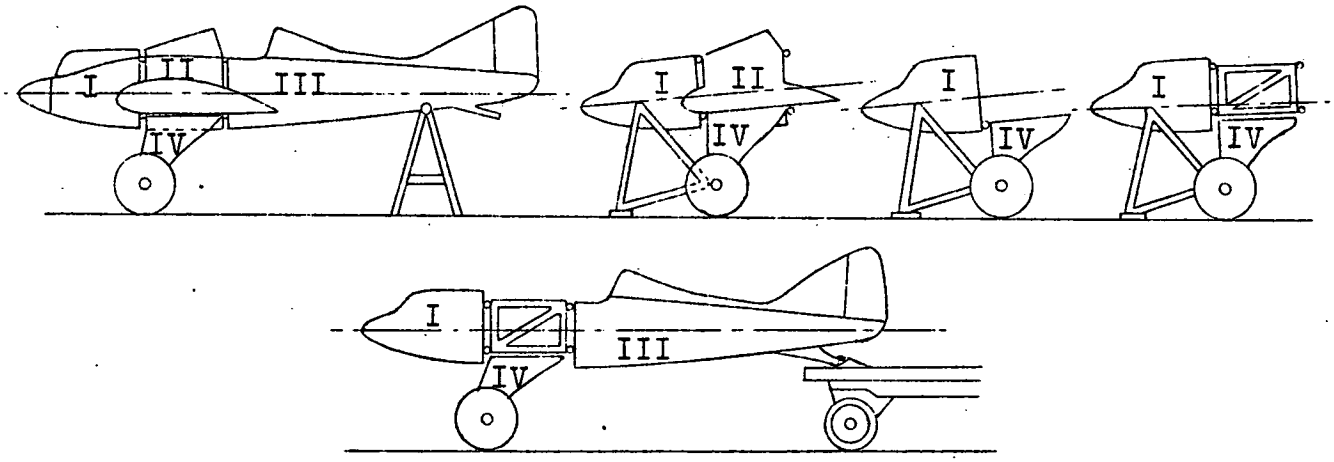


Fig.19 Diagram showing dismantling of airplane for transportation. I, engine block; II, wing and central part of fuselage; III, rear part of fuselage; IV, landing gear; The airplane being placed in line of flight, the engine block is supported by a special frame, thus enabling the removal of the rear part of the fuselage. The wing block is next removed and replaced by a special frame, to which the rear part of the fuselage is then attached. The whole is now ready to be towed behind a trailer, on which the wing is placed.

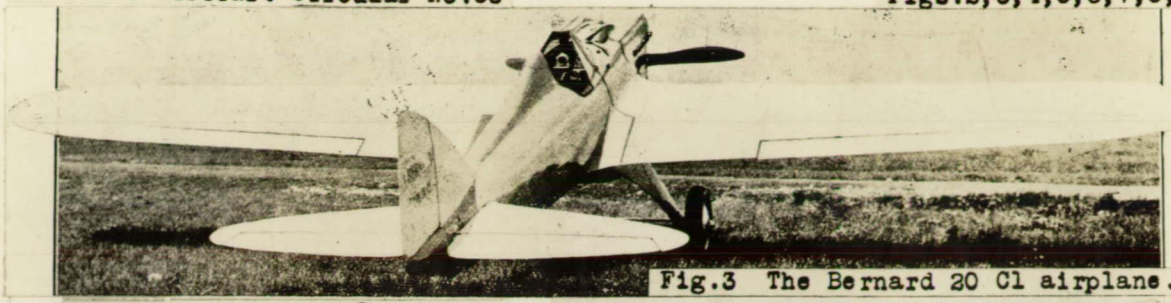


Fig.3 The Bernard 20 C1 airplane.

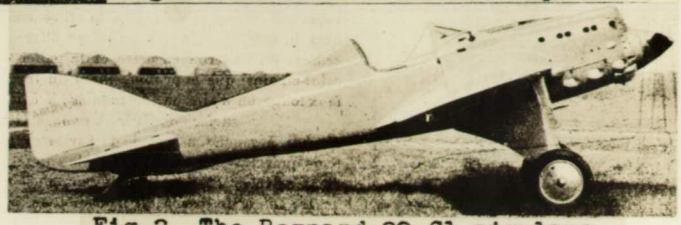


Fig.2 The Bernard 20 C1 airplane.

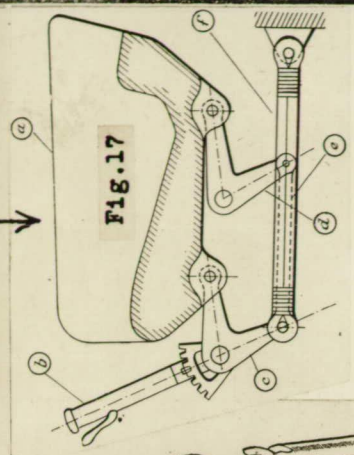


Fig.17 Diagram of adjustable seat. a, seat; b, operating handle; c, front support; d, rear support; e, connecting rod; f, compensating sandow.

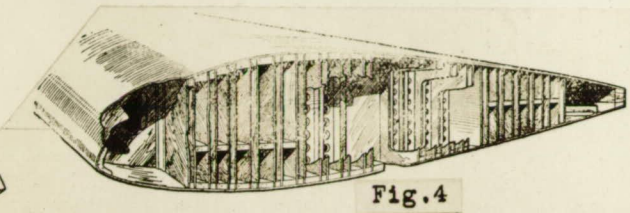


Fig.4

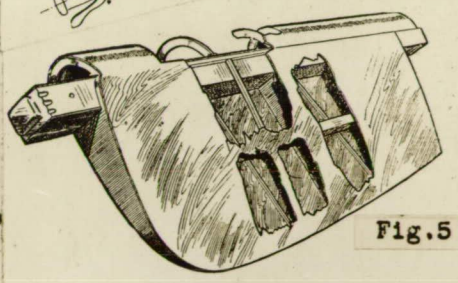


Fig.5

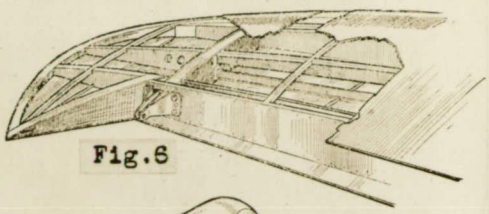


Fig.6

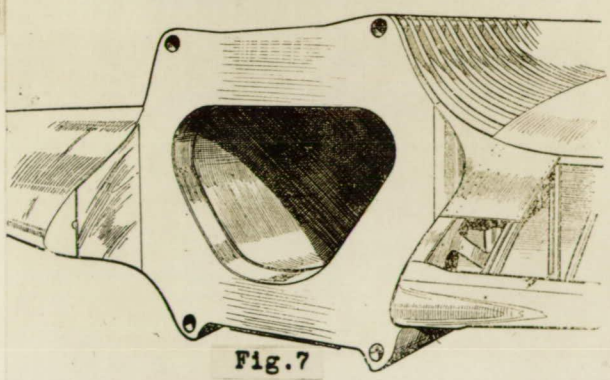


Fig.7

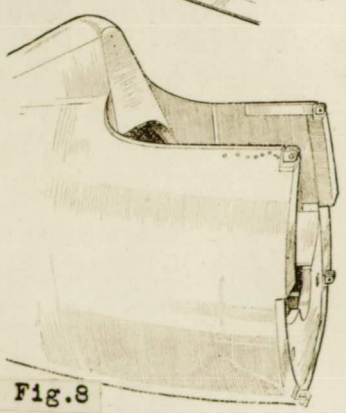


Fig.8

Taken from "L'Aeronautique" May, 1929

Fig.4 Section of wing near fuselage, showing construction method by juxtaposed box girders, forming multiple spars with stressed covering.

Fig.5 Elevator structure of spar and ribs supporting the stressed covering.

Fig.6 Wing tip. Due to the smallness of the stresses at this point, the cellular structure, necessary near the fuselage, is not required. Note the casing for the aileron and the end hinge.

Fig.7 Middle portion of wing, showing central tunnel, which holds rear part of engine, and the holes for the four tubes joining the engine block with the wing and rear portion of fuselage.

Fig.8 Front end of rear part of fuselage, showing the four attachments to the above-mentioned tubes, secured to the fuselage by long strips of metal. Note also the strong headrest for the pilot.

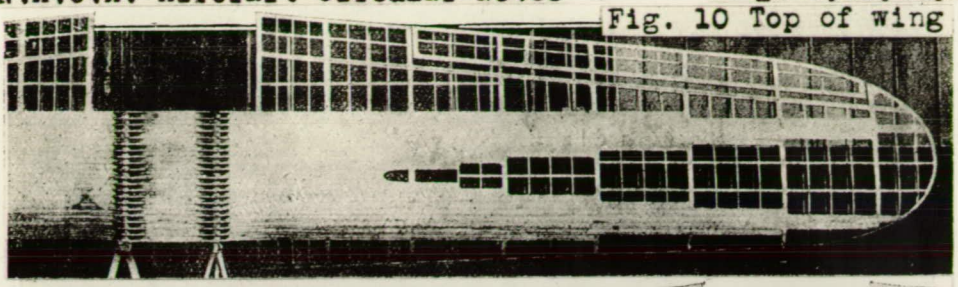


Fig. 10 Top of wing

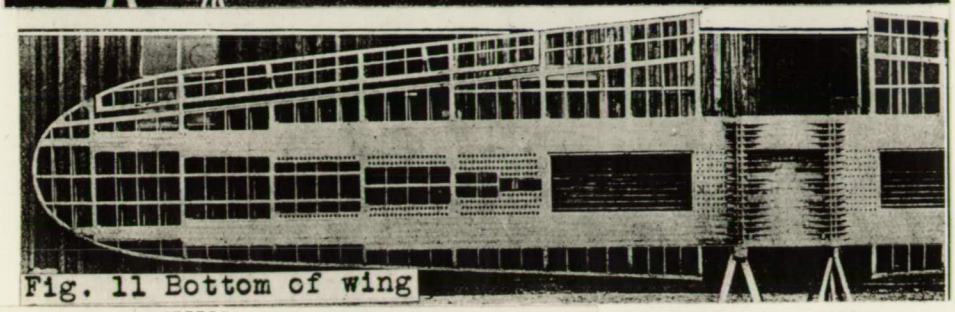


Fig. 11 Bottom of wing

Fig. 13 Wing section at 1/3 the distance from the tip

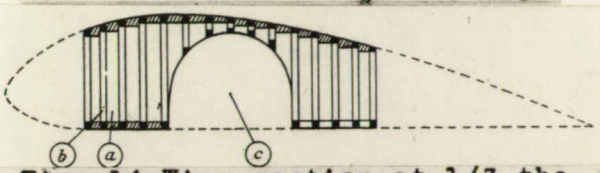


Fig. 14 Wing section at 1/3 the distance from the center

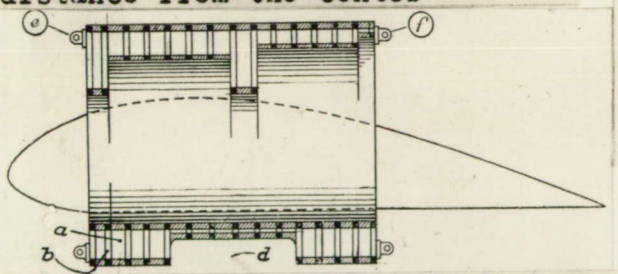


Fig. 15 Cut through center of wing and fuselage. a, large element; b, small element; c, recess for fuel tank; d, recess for radiator & small fuel tank; e, attachment for engine block; f, attachment for rear part of fuselage

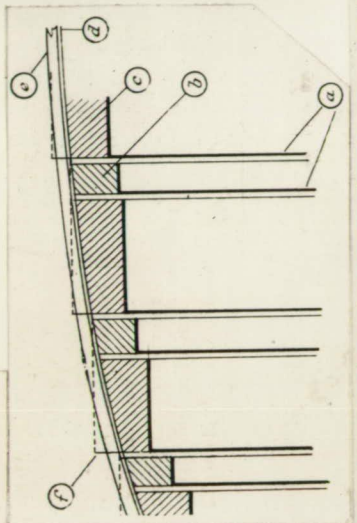


Fig. 16 Detail of wing structure. a, plywood webs; b,c, flanges of large and small elements; d, plywood covering; e, outside strip; f, corner of block, removed with plane after glueing.

Fig. 9 Front of wing before covering.

Taken from "L'Aeronautique" Nov, 1929

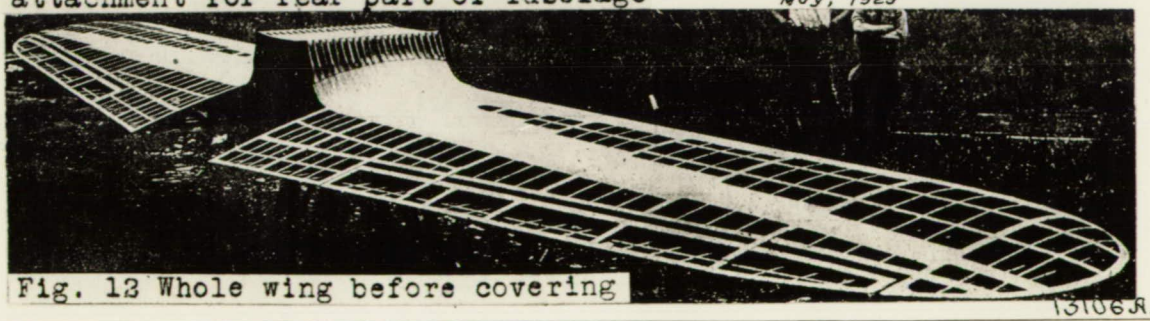


Fig. 12 Whole wing before covering